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A SIMPLISTIC CLASSIFICATION OF WESTERN CANADIAN COAL SEAMS WITH RESPECT TO THEIR POTENTIAL FOR DEVELOPMENT AS UNDERGROUND MINES

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A SIMPLISTIC CLASSIFICATION OF WESTERN CANADIAN COAL SEAMS WITH RESPECT TO THEIR POTENTIAL FOR DEVELOPMENT AS UNDERGROUND MINES

by

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1.0 ABSTRACT

This document describes a simplistic classification of potential underground mining properties in Western Canada with regard to future underground mining methods.

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SIMPLE CLASSIFICATION DES VEINES DE CHARBON DE L'OUEST CANADIEN PAR RAPPORT À LEUR POTENTIEL DANS LE CADRE DU DÉVELOPPEMENT DES MINES SOUTERRAINES

par

Richard Kolada*

1.0

RÉSUMÉ

Ce rapport décrit une simple classification des propriétés possibles de l'exploitation minière souterraine de l'Ouest canadien en vue des futures méthodes d'exploitation minière souterraine.

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2.0 INTRODUCTION

In January 1985 CANMET commissioned a study of 'unconventional coal mining concepts with potential for application in western Canada' (1). The objective of this study was to review available information regarding the next generation of potentially viable underground coal mining methods that could be developed for western Canadian coal seams. Before investigating these methods it was necessary to review the type and geological setting of coal properties with respect to factors that are significant to underground mining. The scope of the study determined that the review could only be of a limited nature and hence the categorization is very generalized. However, despite the limited scope, this work required a considerable amount of effort and is useful in providing an overall view of the type of coal deposits in western Canada that may be mined by underground methods. This information is only a small part of the final report of the study "Unconventional coal mining concepts with potential for application in western Canada" (1), and merits separte publication to ensure that this information is not overlooked during literature searches. All the information provided in this document has been taken from this report.

3.0 INITIAL INVESTIGATIONS

Initial studies were based on the assumption that a potential 'underground' mine property contains coal at depths greter than 100 metres. A cursory review of properties just in Alberta indicated that approximately 150 properties could support at least a small underground mine. At this stage it was evident that it would not be practical in the context of the commissioned report to analyze dta of every property from eastern Saskatchewan to Vancouver Island. Consequently, it was decided to limit the selection of the properties to be reviewed to those 48 on which some exploration work had been conducted in the last ten years, since it was assumed that such properties were more likely to be developed in the next twenty or so years. These properties are listed in Appendix "A".

Group 1

Coal seams are located in normal coal measure strata having gradients from flat to approximately 15 degrees and contains coal seams that have a minable thickness in the range of 1.5 to 1.6 m.

e.g. the Kipp properties nd Shaughnessy owned by Petro Canada and Precambraian Shield Resources Ltd. respectively, or the many other plains coal properties.

Group 2

Coal seams that are located in normal coal measure strata that has a gradient ranging from 15 to a maximum of 35 degrees and contains coal seams with a mineable thickness in the range of 1.5 to 6.0 m.

e.g. the Willow Creek property owned by David Minerals, some parts of; the Sparwood and Greenhills properties of Westar Mining, coal Valley owned by Luscar/Sterco, Smokey River coals etc.

Group 3

Coal seams that are located in normal coal measure strata that has a gradient ranging from approximately 10 degrees to vertical and contain coal seams with a mineable thickness in the range of 6.0 to 30.0 m.

4.0 SELECTION PARAMETERS FOR PROPERTY CLASSIFICATION

A number of characteristics suitable for property classification were evaluated such as gradient, depth, location, etc. However, for simplicity only two were considered as necessary;- gradient and seam thickness. A further subdivision was used in this system of classification to distinguish between the deposits in the Alberta plains and the mountain/foothills which are structurally very distinct from each other. The proposed categories are listed in Table 1.

Table 1 Classification of Properties

Category	Seam Thickness (metres)	Gradient (degrees)	Location
I	1.2 - 6.0	0-15°	Sub Category A (Plains)
II	+6.0	0-15°	
III	1.2 - 6.0	+15°	Sub Category B (Mountains & Foothills)
IV	+6.0	+15°	

5.0 CLASSIFICATION RATIONAL

5.1 Seam Thickness

Current proven underground mining equipment is limited to a cutting height of less than 6 metres in a single pass and it is usually uneconomical to mine a seam with a thickness of less than 1.2 metres. Hence the decision to use these parameters for seam thickness classification.

5.2 Gradient

Mobile mining equipment is in general limited to operating at gradients of less than 14 degrees whereas non-mobile equipment can operate on gradients in excess of 70 degrees. Hence an arbitrary figure of 15 degrees was chosen to subdivide the gradient classification.

5.3 Location

As already mentioned, there is a distinct structural difference between the plains and the mountain/foothills coal. Plains coal is normally less structurally disturbed by faults, folds and similar geological features than the foothills or mountain coals. The difference often has a marked effect on the type of mining methods that can be successfully adopted in each area, although it is recognized that similar properties can exist in both areas and that the same type of mining can sometimes be used for different types of properties. It should be stressed again that the classification shown on Table 1 is very simplified. To assess the viability of a mine many other factors require consideration such as the nature of the surrounding strata, existing infrastructure, coal quality, presence of ground water, economics, analyses etc.

6.0 TYPICAL EXAMPLES OF EACH CATEGORY

Table 1 indicates eight classifications. However, only five of these are applicable to western Canadian coals since there are no plains coals that fall into categories IIA, IIIA, IVA. The number of properties in each category were:

IA-14	IIIA-0
IB-4	IIIB-12
IIA-0	IVA-0
IIB-3	IVb-15

For each of the five groups the following properties were selected as being typical examples of each group.

CATEGORY	PROPERTY
IA	Red Deer, Alberta (TransAlta Utilities)
IB	Babcock Mountain, B.C. (Quintette Coal)
IIB	Coal Valley, Alberta (Luscar Sterco)
IIIB	Willow Creek, B.C. (David Minerals)
IVB	Saxon, B.C. (Denison Mines)

Table 2 summarizes the main characteristics of these properties and their locations are shown on Figure 2. Given below is a brief description of each of these properties.

6.1 Red Deer, Alberta

Two main Ardley coal seams in the Edmonton formation lie below the massive sandstones of the Paskapoo formation. The lower Ardley A zone is relatively thin (often less than one metre). The overlying B zone, which is considered the main resource, is subdivided into the Ardley Main B (1.3 m to 2.3 m), lower Ardley sub B2 (1 to 3 seams) and the lower Ardley sub B1 (usually contains 1 or 2 splits). The roof of the seams are usually massive sandstone or a shale sequence overlain by massive sandstones. The seams vary little in thickness and range in depth between 100 m to 300 m. They closely follow the surface topography and strike North-South with an average dip of 4 m per km to the west. The total reserves of TransAlta, Red Deer area including free and leasehold approximate to 4000 million tonnes of coal.

6.2 Dension Quintette (Babcock Mountain, B.C.)

The main coal seams are located in two distinct formations: the Gates member of the Commotion formation and the Gething formation. The upper portion of the Gates member consists of fine to medium grained sandstone, shale, course sandstone lenses and coal seams. Only the "D" (2.9 M) "F" (2.5 m) and "J" (5.5 m) seams are considered to be mineable. The roof of these seams varies between shale to fine grained sandstone, except for the "D" seam which is coarse or pebble conglomerate. The Gething formation contains consistent coal seams 2 m to 4 m thick in a strata of sandstone, shale and thickly bedded to massive conglomeritic sandstone.

The coal measures at Quintette are located in broad synclines and sharper anticlines separated by medium to high angle thrust faults with vertical displacements of up to 100 m. The main underground reserves are the "D", "F" and "J" seams which are located in large structurally continuous blocks on the flanks of the synclines and anticlines, dipping between 5 to 6 degrees and ranging in depth from between 100 m to 450 m. These reserves are known as the Babcock reserves and consist of approximately 160 million tonnes.

6.3 Luscar (Sterco) Coal Valley Mine, Alberta

The coal measures are concentrated in a 21 m interval of the Palaocene section. Of the five main seams only three are considered to be economically mineable. These are; the Val D'Or, Upper Silkstone and Mynheer. The Coal Valley Mine reserves are in the foothills area and are consequently structurally deformed to a considerable extent due thrust faulting and folding.

The Mynheer Seams located at the base of the coal measures, ranges in thickness between 5 m to 10 m; and has numerous bentonite and shale partings. The Mynheer seam is subdivided into A and B zones each of which requires distinctly different mining methods due to their different geological features. The A zone consists of an overturned assymetrical crest containing steeply dipping thrust fault which has raised the seam above the present topographical level. Extension shearing and rotation has resulted in the coal taking a 'pod' shape. The B zone dips an average of 12 degrees to the southwest and is interrupted at the south end by a transverse fault and at the north end, where it outcrops to the surface.

The Silkstone seams lies approximately 50 metres above the Mynheer seams and is in places split by three to six metres of sand and siltstone into upper and lower seams. The upper seam averages 3.5 metres in thickness and this part of the seam is considered economically mineable by underground methods.

The Val D'or seam interval is about 10 metres thick, but has up to six partings, one of which is 3.5 m thick. The seam dips approximately 12 degrees. Mining of this seam is complicated due to the selective mining methods that are necessary to remove the parting material.

Forty million tonnes of proven reserves are contained within the mine site that can be recovered by surface mining and an additional thirty

million tonnes that can be recovered by underground mining.

6.4 Willow Creek, B.C. (50 km west of Chetwynd)

This coal filed contains eight seams varying in thickness between 2 to 4.2 metres. The strata consists of fine grained cherty to quartzose sandstone, rusty shale, carbonaceous mudstone and minor conglomerate. The property is located on a structure known as the Willow anticlinorium. Small gentle folds occur to the east of the broad anticline and the synclinal axis is marked by a shear/fault zone which is visible in outcrop.

The underground mineable section of the structure dips at 34 to 37 degrees and has a total reserve of 28 million tonnes if calculated to a depth of 400 metres.

6.5 Denison - Saxon B.C.

The property is located in the Peace River coal field south east of the Quintette property. The coal bearing sequence is in the Commotion formation which is divided into three members of which the Gates member is the most economically important. The Gates member is mainly non-marine and consists of sandstone, conglomerate, coal, shale and mudstone and has an average thickness of 365 metres. Within this region there are six potentially economic coal seams with an aggregate thickness of 18 metres. The Gates member is contained in a large syncline the eastern section of which is attractive for underground mining. In this section there are three significant seams numbered 1, 2 and 4. Seam 1 varies in thickness between 2.5 to 14 metres. The roof consists of sandstone grading upward to silkstone. The floor is sandstone. Seam 2 varies between 2 to 4 metres in thickness. The roof is sandstone which grades into coglomerate to the south. Seam 4 varies in thickness between 2 to 9 metres and has a floor of sandstone and a roof of shale and claystone (1 - 2 metres).

The underground reserves in the Saxon area have been calculated to a depth of 500 metres to be approximately 290 million tonnes.

7.0 CONCLUSION

This document has identified coal mining properties that are likely to be suitable for future underground mining in the event that economic

considerations indicate that such actions would be profitable. These properties can be generally classified into five groups that are identified by parameters that are significant to potential underground mining methods. An example of each category is also given.

8.0 REFERENCES

1. A Review of Unconventional Coal Mining Concepts with Potential Application to Western Canada. Moneco Consultants Ltd., Nov. 1985, CANMET project No. 202803.

APPENDIX A

Possible Underground Mines that Could be Brought into Production in +20 Years

Possible Underground Miens that Could be Brought into Production in +20 Years

Property	Owner	Coal Mining Conditions
Hat Creek (B.C.)	B.C. Hydro	Massive, several + 30 m thick seams located in a large dipping syncline.
Sukunka (B.C.)	B.P. Resources	Fairly flat 2.4 - 3.0 m thick seams.
Copton (West)	Amax Petroleum	Steep seams to 6 m thick seams.
Kipp	Petro-Canada	Flat seams to 1.8 m thickness.
Monkman (B.C.)	Petro-Canada	Multi-seams dipping 15 to 25°. Thickness to 6m.
Ram River	Petro-Canada	Seams to 3 m thick dipping 10 to 20°.
Innisfail	Petro-Canada	Flat seams up to 1.8 m thick.
Cardinal River	Consol/Luscar	Single 6 to 30 m thick seam very steeply pitching.
Coal Valley	Luscar/Sterco	Seams 5 to 10 m thick dipping at 10 to 15°.
Grassy Mountain	Consol/Home Oil	Seams to 3 m thickness dipping from 10 to 50°.
Ram River	Consol/Home Oil	Seams to 3.9 m thickness dipping from 10 to 30°.
Nordegg	Consol/Home Oil	Seams to 3 m thickness dipping from 10 to 20°.
Adanac	Consol/Home Oil	Seams to 3 m thickness dipping from 10 to 50°.
Mountain Park/Cadoman	Consol/Luscar	Seams to 7.5 m thickness dipping from 10 to 60°.

Property	Owner	Coal Mining Conditions
Cinnabar Peak Mines	Cinnabar Peak Mines Ltd.	Seams to 2.4 m thickness, dipping from 20 to 35°.
Smoky River Coals	McIntyre Mines Ltd.	Seams to 10.5 m thickness dipping from 20 to 55°.
Tent Mountain (Coleman)	Norcen Energy Resources	Seams to 9 m thickness, dipping from 10 to 60°.
Bowron River (B.C.)	Norco Resources Ltd.	Seams to 6 m thickness dipping from 15 to 30°.
Shaughnassy	Pre-Cambrian Shield Resources	Fairly flat seams 1.8 m thick.
Bonnet Plume	Seagull Resources	Fairly flat seams to 2.4 m thick.
Buffalo Hills	Seagull Resources	Fairly flat seams to 3.9 m thick.
Mount Spieker (B.C.)	Ranger Oil	Seams to 3.6 m thickness, dipping 15 to 30°.
Bullmoose (B.C.)	Teck Corporation	Seams to 6 m thickness, dipping 15 to 35°.
Innisfail	TransAlta Utilities	Fairly flat seams up to 3.6 m thick.
Drumheller	TransAlta Utilities	Fairly flat seams up to 3.6 m thick.
Red Deer	TransAlta Utilities	Fairly flat seams up to 3.6 m thick.
Sparwood (B.C.)	Westar Mining	Seams to 15 m thickness, dipping 10 to 55°.
Greenhills (B.C.)	Westar Mining	Seams to 6 m thickness, dipping 10 to 40°.
Hosmer/Wheeler (B.C.)	Westar Mining	Seams to 7.5 m thickness, dipping 10 to 20°.
Line Creek Mine (B.C.	Crowsnest Resources Ltd.	Seams to 9 m thickness, dipping 10 to 50°.

Property	Owner	Coal Mining Conditions
Quinsam Mine (B.C.)	Weldwood Industries	Seams to 3 m thickness, dipping to 15°.
East Coulee Mine (Drumheller)	Centry Coals Ltd.	Fairly flat, 1.8 m thick seams.
Tulameen (B.C.)	Cypruss Anvil Mining	Seams to 18 m thickness, dipping 10 to 30°.
Torrens (B.C.)	Cypruss Anvil Mining	Seams to 7.5 m thickness, dipping 10 to 30°.
Willow Creek (B.C.)	David Minerals	Seams to 3.6 m thickness, dipping 20 to 30°.
Quintette (B.C.)	Denison Mines	Multiple seams to +6 m thickness, dipping 10 to 50°.
Saxon (B.C.)	Denison Mines	Multiple seams 3 to 10 m thick, dipping 10 to 45°.
Belcourt (B.C.)	Denison Mines	Multiple seams to +6 m thickness, dipping 10 to 40°.
Elk River Mine (B.C.)	Elco Mining Co. and	Multiple seams to +6 m thicknes, dipping 10 to 45°.
Fall Creek	Dome	Two seams 2.5 and 3.6 m thickness, dipping to 20°.
Gregg River Mines	Manalta	One seam 15 to 30 m thick, dipping 10 to 60°.
Shaughnassy	Fording Coal	Fairly flat lying seams to 1.8 m thick.
Eagle Mountain (B.C.)	Fording Coal	Seams to 7.5 m thick, dipping 10 to 30°.
Starkey Mines	Genstar	Fairly flat lying 1.8 to 2.4 m thick seams.
Cooking Lake	Several	Fairly flat lying seams to 3.4 m thickness.

Property	Owner	Coal Mining Conditions
Wizard Lake	Several	Fairly flat lying 2.4 m thick seam.
Highvale - Low Water	TransAlta Utilities	Fairly flat lying seams to 5.1 m thickness.
Chancellor	Several	Fairly flat lying seam 1.8 m thickness.